

Research on Digital Innovation Strategy Path for Pharmaceutical Manufacturing Enterprises in Henan Province under the Background of Digital Economy

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Abstract: As a significant pharmaceutical manufacturing base in China, Henan Province shoulders crucial missions and responsibilities in enhancing the development level of pharmaceutical manufacturing enterprises and strengthening industry competitiveness. Against the backdrop of the vigorous development of the digital economy, digital innovation transformation has emerged as the core path for China's manufacturing industry to break through development bottlenecks and achieve high-quality development. Implementing a digital innovation strategy to promote industrial upgrading has become a widespread consensus in both industry and academia. However, the scientific planning and efficient implementation of digital innovation strategies to empower pharmaceutical manufacturing enterprises to continuously enhance their core competitiveness and achieve high-quality development goals remain key challenges for Henan's pharmaceutical manufacturing industry.

Keywords: Digital economy; Pharmaceutical manufacturing enterprises; Henan Province; Digital innovation

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1. Introduction

Amid the accelerated evolution of global technological innovation and industrial transformation, the digital economy has emerged as the core force reshaping the global competitive landscape. According to data from the China

Academy of Information and Communications Technology ^[1], China's digital economy surpassed 50 trillion yuan in 2023, accounting for 41.5% of GDP and becoming the primary engine of economic growth.

As a strategic pillar of the national economy, the digital transformation of manufacturing not only determines the industry's future but also impacts public health security and national strategic safety ^[2]. Henan Province, a major pharmaceutical manufacturing hub in China with a complete industrial chain covering biopharmaceuticals, chemical bulk drugs, and modern traditional Chinese medicine, achieved a total pharmaceutical industrial output value exceeding 280 billion yuan in 2023—7.2% of the national total. The province has cultivated leading enterprises such as Hualan Biology and Lingrui Pharmaceuticals. However, despite these achievements, Henan's pharmaceutical manufacturing sector still faces challenges under the digital economy wave, including efficiency bottlenecks in traditional production models, insufficient innovation capacity, and weak industrial coordination. The Henan Province 14th Five-Year Plan for High-Quality Manufacturing Development explicitly states that the pharmaceutical industry should exceed 300 billion yuan by 2025 ^[3], with digital transformation identified as the critical pathway to achieve this goal.

Globally, pharmaceutical companies are accelerating digital innovation. For instance, Pfizer reduced drug development cycles by 30% using AI technology ^[4], while Alibaba Health employed blockchain for comprehensive pharmaceutical supply chain traceability ^[5]. However, Henan's pharmaceutical enterprises lag in digitalization, characterized by limited application scenarios, prominent data silos, and a shortage of versatile talents. Against this backdrop, this study examines the current status and challenges of digital innovation in Henan's pharmaceutical manufacturing sector. Based on provincial realities, it proposes a "government-guided, enterprise-led, ecosystem-coordinated" three-dimensional strategic approach, aiming to provide theoretical and practical guidance for advancing the high-quality development of Henan's pharmaceutical manufacturing industry.

2. Current status of digital innovation development in Henan pharmaceutical manufacturing enterprises

2.1. Gradual improvement of policy support system

The Henan Provincial Government attaches great importance to the digital development of the pharmaceutical manufacturing industry and has introduced multiple policies in recent years to promote industrial upgrading. In 2023, the General Office of the Henan Provincial People's Government issued the "Henan Province Digital Economy Development Action Plan (2023–2025)," explicitly advocating the integration of new-generation information technology with manufacturing and supporting the digital transformation of pharmaceutical manufacturing enterprises. The "14th Five-Year Plan" of Henan Province in 2021 listed the digital transformation of manufacturing as a key task and proposed the strategic goal of building a "Digital Henan" ^[3].

2.2. Continuous strengthening of digital infrastructure

Henan Province has made remarkable progress in digital infrastructure construction, providing support for the

transformation of the pharmaceutical manufacturing industry. By the end of 2024, the province's software business revenue is expected to exceed 200 billion yuan ^[6], the scale of computing power and big data industries will surpass 100 billion yuan, and the core artificial intelligence industry will reach 80 billion yuan. Cities such as Zhengzhou and Luoyang have established multiple provincial-level big data centers, and 5G base stations cover major industrial parks across the province.

2.3. Rapid expansion of the pharmaceutical manufacturing industry scale

The pharmaceutical manufacturing industry is one of the pillar industries in Henan Province, with its industrial scale expected to reach 300 billion yuan by 2025. According to the "Henan Province Pharmaceutical Industry Development Report (2023)," the pharmaceutical industrial revenue of Zhengzhou, Luoyang, and Xinxiang accounts for over 60% of the province ^[7], demonstrating a significant industrial agglomeration effect. Zhengzhou has formed a bio-medicine and high-end medical device industrial chain; Luoyang and Xinxiang have prominent advantages in chemical raw materials and pharmaceutical preparations; Nanyang, Jiaozuo, and other places have witnessed rapid development in Chinese herbal medicine planting and modern Chinese medicine industries. Enterprises such as Lingrui Pharmaceutical, Wanxi Pharmaceutical, and Furen Pharmaceutical have been selected as the top 100 pharmaceutical enterprises in China, while bio-pharmaceutical enterprises represented by Hualan Bio and Antu Bio are rising rapidly.

3. Challenges faced by digital innovation in Henan pharmaceutical manufacturing enterprises

3.1. Severe shortage of interdisciplinary talents

Henan's pharmaceutical manufacturing enterprises have sufficient talent reserves in traditional R&D and production fields, but lack professionals with both medical backgrounds and digital technology capabilities. There is a widespread shortage of specialized personnel in areas such as digital strategic planning, big data analysis, and artificial intelligence applications, which restricts the in-depth promotion of digital transformation ^[8].

3.2. Need to expand digital application scenarios

Current digital applications in Henan's pharmaceutical manufacturing enterprises are mainly concentrated on automation upgrades in production (such as smart manufacturing production lines and IoT device applications), with fewer innovative applications in areas like drug R&D (e.g., AI-assisted drug design) ^[9], supply chain management (blockchain traceability), and precision marketing (big data analysis of user needs). The integration of digitalization and business operations is insufficient.

3.3. Urgent need to enhance enterprise digital awareness

Some managers of Henan's pharmaceutical manufacturing enterprises lack a full understanding of the strategic value

of digital transformation, still viewing digitalization as a cost rather than a strategic opportunity ^[10]. Some enterprises have not formulated clear digital development plans and only apply cloud computing, big data, and other technologies at a basic level.

3.4. Unbalanced digital infrastructure construction

Although the overall digital infrastructure in Henan Province has improved, the internal digital construction levels of pharmaceutical manufacturing enterprises vary widely. Small and medium-sized enterprises generally face issues such as insufficient network bandwidth, limited data storage and processing capabilities ^[11], and low penetration rates of industrial software, which hinder the deepening of digital transformation.

4. Countermeasures and suggestions for the development of digital innovation strategies in Henan pharmaceutical manufacturing enterprises

4.1. Government level

4.1.1. Strengthening policy supply and guidance

Governments at all levels in Henan Province should strengthen policy guidance to create a favorable policy environment for the digital transformation of pharmaceutical manufacturing enterprises. First, local governments should actively implement the central government's directives on integrating digital technology with the tourism industry and introduce special policies and measures to promote the digital transformation of local pharmaceutical manufacturing enterprises, forming a multi-level policy system. Second, governments at all levels should further improve financial and tax policies that facilitate the digital transformation of pharmaceutical manufacturing enterprises and strengthen financial support. Third, a digital technology standard system should be established to enhance the protection and management of intellectual property rights in the digital field and ensure the data security of pharmaceutical manufacturing enterprises.

4.1.2. Strengthening organizational leadership

Under the unified leadership of the Party Central Committee, governments at all levels in Henan Province should formulate and improve specific action plans to promote digital innovation in the pharmaceutical manufacturing industry within the national planning framework for digital economy development, playing a leading role in the digital innovation transformation of pharmaceutical manufacturing enterprises.

4.1.3. Strengthening technical and resource support for digital innovation in pharmaceutical manufacturing enterprises

Henan's pharmaceutical manufacturing enterprises urgently need advanced digital technologies and supporting

resources for digital innovation. Therefore, governments at all levels should actively provide efficient resource support and digital technology development platforms to assist pharmaceutical manufacturing enterprises in implementing digital innovation strategies.

4.2. Enterprise level

4.2.1. Enhancing managers' awareness of digital innovation

Enterprise managers are the formulators and decision-makers of pharmaceutical manufacturing enterprise strategies. Their understanding of digital innovation strategies is crucial to whether enterprises can successfully choose and implement digital innovation strategies. Therefore, enterprise managers should fully recognize the importance of digital innovation in the current digital economy era for shaping enterprise core capabilities and gaining competitive advantages.

4.2.2. Controlling the rhythm of digital innovation strategy implementation

Digital innovation strategy transformation is a systematic, complex, long-term, and high-cost project. Therefore, when promoting the implementation of digital innovation strategies, enterprises should pay attention to the breadth and depth of digital innovation, ensuring that the strategy matches the enterprise's resources and capabilities. Excessive innovation may lead enterprises into a transformation quagmire.

4.2.3. Strengthening the introduction and cultivation of digital technology talents

In the past, Henan's pharmaceutical manufacturing enterprises tended to recruit medical-background talents. In the future, they should strengthen the introduction of digital technology talents while also providing digital technology training for internal medical-background talents to turn them into interdisciplinary talents with both digital and medical technologies.

4.2.4. Improving enterprise digital infrastructure construction

The construction of digital technology infrastructure is crucial for the digital transformation of pharmaceutical manufacturing enterprises. Digital technology infrastructure is the most important tool for enterprises to carry out digital transformation and the core element to ensure its success. During the digital transformation process, pharmaceutical manufacturing enterprises should always pay attention to the matching degree between digital infrastructure resources and the digital transformation strategy. Excessively high-level digital infrastructure construction will increase unnecessary costs for enterprises, while excessively low-level construction will hinder the implementation of the digital transformation strategy. Therefore, pharmaceutical manufacturing enterprises need to continuously improve the construction of digital infrastructure during the implementation of the digital transformation strategy.

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Disclosure statement

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